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Financial Performance Analysis by Using TOPSIS and ELECTRE Methods: A Research on Turkish Construction Sector Companies

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Abstract

In this study, financial performances of six companies which traded in Istanbul Stock Exchange (BIST) and operated in construction sector in Turkey were evaluated with TOPSIS and ELECTRE methods –after global financial crisis- for the year of 2011. Construction sector is one of the most important and developing sector in Turkey. This is why this topic has been chosen. Companies are ranked according to their financial ratios which obtained from their balance sheets. Analytic Hierarchy Process (AHP) was used on the process of calculation of criteria weights. As a result, it is found that both technique produce same results.

Keywords: Construction Sector; Multi-Criteria Decision Making; TOPSIS; ELECTRE.

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1. Introduction

According to TurkStat data, at the end of 2014 the construction sector was worth around €28.1bn at current prices, up from €24.5bn a year earlier. That represented 4.6% of GDP, though if a constant price formula is used, with 1998 as the baseline, the figure rises to 5.9%. A report from the European construction sector body, European International Contractors (EIC), argues, however, that when the sector's impact on other parts of the economy is taken into account, the share of GDP attributable to it could be as high as 30%, with some 10% of the working population employed in and around the sector. At current prices, meanwhile, the sector has shown consistent growth every year since the global economic downturn hit Turkey hard in 2009. That year, the sector shrank 18.1%, but it rebounded quickly, growing by 24.9% in 2010 and 26.5% in 2011 [1]. The general aim of this study is to evaluate financial performance –after global financial crisis- in the year 2011, of companies which operated in construction sector in Turkey and make a huge contribution to Turkish economy. In this context, required data is obtained from balance sheets of companies and then performance ranking, for the year of 2011, is made by using TOPSIS and ELECTRE methods.

Firstly, similar works are reviewed. Next, methods and financial ratios which used in the study are explained. In the following section, some explanations are given about financial performance analysis that carried out by using TOPSIS and ELECTRE methods. Finally, basic findings of the study and results are discussed.

2. Literature Review

Some studies which related to TOPSIS and ELECTRE methods in the literature are listed as follow. Reference [2] had studied the evaluation of the performance of Turkish economy with seven basic economic ratios for the years of 1986-2006 by using TOPSIS method and they had found that the best performance was appeared in the year of 1986.

Reference [3] had carried out the performance measurements for the big scale of five automotive companies which traded in Istanbul Stock Exchange by using TOPSIS method. As a result performance ranking had been shown. [4] had used TOPSIS method for evaluation of the customer service satisfaction for fast food industry. Four fast food restaurants which operated in China and eight fast food restaurants which operated in USA had been included in the study. At the end, the factors that affecting the competition had been determined and ranking according to customer's level of satisfaction had been made. Reference [5] found that TOPSIS and Fuzzy AHP methods can be used to measure of performance of Turkish cement firms.

Reference [6] applied TOPSIS and ELECTRE method to food industry companies to evaluate their financial performances. They had revealed that these methods allow reliable results in the evaluation of financial performance. Reference [7] had carried out financial performance analysis by using ELECTRE method for the each year 2006-2010 for the banks. 13 Turkish banks and 11 foreign-capitalized banks which founded in Turkey had included in the study. The results showed that Turkish banks had carried out better performance than foreign-capitalized banks in financial performance analysis.

3. Data and Methodology

The data set of the study consists of financial ratios that obtained from financial statements of companies which operated in Turkey and traded in Istanbul Stock Exchange (BIST). The process of choosing ratios was consulted on experts and additionally reviewed similar studies on literature. In order to determine criteria weights, consulted on experts and benefited from AHP (Analytic Hierarchy Process) as well. Financial ratios are shown in Table 1.

Table 1: Financial Ratios Used in Study

NUM.	CODE	RATIOS
1	CR	Current Ratio
2	LR	Liquidity Ratio
3	ATR	Asset Turnover Ratio
4	FLO	Financial Leverage Ratio
5	ROA	Return on Assests (Net Profit/Total Assets)
6	ROE	Return on Equity (Net Profit/Shareholder's Equity)
7	ROS	Return on Sales (Net Profit/ Net Sales Revenue)
8	OP	Operating Profitability (Operating Profit/Net Sales Revenue)

3.1 Methodology

TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) method and ELECTRE method (Elimination and Choice Translating Reality) are two of well-known decision making method. The ELECTRE method was developed as multi-criteria decision making technique by Benayoun, Roy & Sussman (1966). In this method, an alternative decision points for each assessment factor is based on comparisons between the dual advantages. After those comparisons, concordance and discordance matrix create and the research questions solve by using these matrix. The TOPSIS method was developed by Hwang & Yoon (1981) basis of the alternative selection to the shortest distance to Positive – Ideal Solution and the longest distance to the Negative-Ideal Solution of the DMUs.

4. Findings

In this study, financial performances of six companies that traded in BIST and operated in construction sector in Turkey are evaluated with TOPSIS and ELECTRE methods using financial statements. Companies that included study are as follows: Atac Construction & Industry (ATAC), Ayes Steel Meshing (AYES), Berkosan Insulation (BRKSN), Borova Construction (BROVA), Enka Construction (ENKAI) and Tav Airports (TAVHL). Standard decision matrix is created for six companies and shown in Table 2.

4.1. Results of TOPSIS Method

Table 2: Decision Matrix

COMPANIES	CRITERIA							
	CR	LR	ATR	FLO	ROA	ROE	ROS	OP
ATAC	0,740	0,592	0,287	0,581	0,070	0,179	0,260	0,040
AYES	2,295	0,879	2,158	0,356	0,064	0,099	0,029	0,046
BRKSN	2,668	1,808	0,614	0,302	0,023	0,033	0,038	0,028
BROVA	1,264	1,264	1,967	0,759	0,030	0,125	0,015	0,013
ENKAI	2,300	2,075	0,597	0,360	0,062	0,102	0,104	0,148
TAVHL	1,611	1,569	0,400	0,729	0,023	0,087	0,059	0,180

Table 3: Normalized Decision Matrix

COMPANIES	CRITERIA							
	CR	LR	ATR	FLO	ROA	ROE	ROS	OP
ATAC	0,156	0,166	0,093	0,434	0,575	0,647	0,895	0,165
AYES	0,485	0,246	0,700	0,266	0,526	0,358	0,100	0,189
BRKSN	0,564	0,506	0,199	0,226	0,189	0,119	0,131	0,115
BROVA	0,267	0,354	0,638	0,567	0,247	0,452	0,052	0,054
ENKAI	0,486	0,581	0,194	0,269	0,510	0,369	0,358	0,609
TAVHL	0,340	0,439	0,130	0,544	0,189	0,314	0,203	0,741

Table 4: Results of TOPSIS Method

C* Values	Preference	Companies
0,655666	1	ATAC
0,385739	2	AYES
0,166324	6	BRKSN
0,327013	4	BROVA
0,374525	3	ENKAI
0,188210	5	TAVHL

According to results of TOPSIS method the best financial performance was carried out by ATAC Construction in the year of 2011. Now, to compare the TOPSIS results, ELECTRE method will be applied to the data.

4.2 Results of ELECTRE Method

To employ ELECTRE method, first step is to create concordance and discordance matrix. At this step, after pairwise comparisons it is reveal that which company has superiority to the others or not. For example, let's

look to first row on the Table 5. ATAC company has the better value than AYES for the criteria number 5,6 and 7 (ROA, ROE and ROS respectively), as seen on the Table 3. Contrast, ATAC Company has worst value than AYES for the criteria number 1,2,3,4 and 8 (CR, LR, ATR, FLO and OP respectively), as seen on the Table 3.

Table 5: Determination of Concordance-Discordance Clusters and Indexes

Companies	Concordance	Conc. Index	Discordance	Discor. Index
(ATAC,AYES)	5,6,7	0,562	1,2,3,4,8	0,383
(ATAC,BRKSJ)	5,6,7,8	0,595	1,2,3,4	0,189
(ATAC,BROVA)	4,5,6,7,8	0,679	1,2,3	0,284
(ATAC,ENKAI)	5,6,7	0,562	1,2,3,4,8	0,383
(ATAC,TAVHL)	4,5,6,7	0,646	1,2,3,8	0,140
(AYES,ATAC)	1,2,3,4,8	0,438	5,6,7	0,617
(AYES,BRKSJ)	3,5,6,8	0,519	1,2,4,7	0,131
(AYES,BROVA)	1,3,4,5,7,8	0,840	2,6	0,121
(AYES,ENKAI)	3,4,5	0,454	1,2,6,7,8	0,485
(AYES,TAVHL)	1,3,4,5,6	0,632	2,7,8	0,211
(BRKSJ,ATAC)	1,2,3,4	0,405	5,6,7,8	0,811
(BRKSJ,AYES)	1,2,4,7	0,481	3,5,6,8	0,869
(BRKSJ,BROVA)	1,2,4,7,8	0,514	3,5,6	0,643
(BRKSJ,ENKAI)	1,3,4	0,361	2,5,6,7,8	0,945
(BRKSJ,TAVHL)	1,2,3,4,5	0,560	6,7,8	0,524
(BROVA,ATAC)	1,2,3	0,321	4,5,6,7,8	0,716
(BROVA,AYES)	2,6	0,160	1,3,4,5,7,8	0,879
(BROVA,BRKSJ)	3,5,6	0,486	1,2,4,7,8	0,357
(BROVA,ENKAI)	3,6	0,331	1,2,4,5,7,8	0,652
(BROVA,TAVHL)	3,5,6	0,486	1,2,4,7,8	0,365
(ENKAI,ATAC)	1,2,3,4,8	0,438	5,6,7	0,691
(ENKAI,AYES)	1,2,6,7,8	0,546	3,4,5	0,485
(ENKAI,BRKSJ)	2,5,6,7,8	0,639	1,3,4	0,055
(ENKAI,BROVA)	1,2,4,5,7,8	0,785	3,6	0,348
(ENKAI,TAVHL)	1,2,3,4,5,6,7	0,967	8	0,028
(TAVHL,ATAC)	1,2,3,8	0,354	4,5,6,7	0,962
(TAVHL,AYES)	2,7,8	0,368	1,3,4,5,6	0,789
(TAVHL,BRKSJ)	5,6,7,8	0,595	1,2,3,4	0,476
(TAVHL,BROVA)	1,2,4,7,8	0,514	3,5,6	0,635
(TAVHL,ENKAI)	8	0,033	1,2,3,4,5,6,7	0,972
	C_{avr}	0,509	D_{avr}	0,504

Table 6: Concordance and Discordance Matrix

COMPANIES	Conc. Index	$C_{pq} \geq C_{avr}$	Discord. Index	$D_{pq} \leq D_{avr}$	PREFERENCE
(ATAC,AYES)	0,562	YES	0,383	YES	ATAC-->AYES
(ATAC,BRKSJ)	0,595	YES	0,189	YES	ATAC-->BRKSJ
(ATAC,BROVA)	0,679	YES	0,284	YES	ATAC-->BROVA
(ATAC,ENKAI)	0,562	YES	0,383	YES	ATAC-->ENKAI
(ATAC,TAVHL)	0,646	YES	0,140	YES	ATAC-->TAVHL
(AYES,ATAC)	0,438	NO	0,617	NO	
(AYES,BRKSJ)	0,519	YES	0,131	YES	AYES-->BRKSJ
(AYES,BROVA)	0,840	YES	0,121	YES	AYES-->BROVA
(AYES,ENKAI)	0,454	NO	0,485	YES	
(AYES,TAVHL)	0,632	YES	0,211	YES	AYES -->TAVHL
(BRKSJ,ATAC)	0,405	NO	0,811	NO	
(BRKSJ,AYES)	0,481	NO	0,869	NO	
(BRKSJ,BROVA)	0,514	YES	0,643	NO	
(BRKSJ,ENKAI)	0,361	NO	0,945	NO	
(BRKSJ,TAVHL)	0,560	YES	0,524	NO	
(BROVA,ATAC)	0,321	NO	0,716	NO	
(BROVA,AYES)	0,160	NO	0,879	NO	
(BROVA,BRKSJ)	0,486	NO	0,357	YES	
(BROVA,ENKAI)	0,331	NO	0,652	NO	
(BROVA,TAVHL)	0,486	NO	0,365	YES	
(ENKAI,ATAC)	0,438	NO	0,691	NO	
(ENKAI,AYES)	0,546	YES	0,485	YES	ENKAI-->AYES
(ENKAI,BRKSJ)	0,639	YES	0,055	YES	ENKAI-->BRKSJ
(ENKAI,BROVA)	0,785	YES	0,348	YES	ENKAI-->BROVA
(ENKAI,TAVHL)	0,967	YES	0,028	YES	ENKAI-->TAVHL
(TAVHL,ATAC)	0,354	NO	0,962	NO	
(TAVHL,AYES)	0,368	NO	0,789	NO	
(TAVHL,BRKSJ)	0,595	YES	0,476	YES	TAVHL-->BRKSJ
(TAVHL,BROVA)	0,514	YES	0,635	NO	
(TAVHL,ENKAI)	0,033	NO	0,972	NO	
	C_{avr}	0,509	D_{avr}	0,504	

C_{avr} : Average of Concordance Indexes , D_{avr} : Average of Discordance Indexes

Here, concordance indexes are compared with average of concordance indexes and discordance indexes are

compared with average of discordance indexes. The reason of this is to identify the superior preferences. If $C \geq C_{avr}$ and $D \leq D_{avr}$ then “YES” is highlighted. Otherwise, $C < C_{avr}$ and $D > D_{avr}$ then “NO” is highlighted. Identified superiority matrix can be seen in Table 6. The figure that created as a result of all ranking of ELECTRE is shown below.

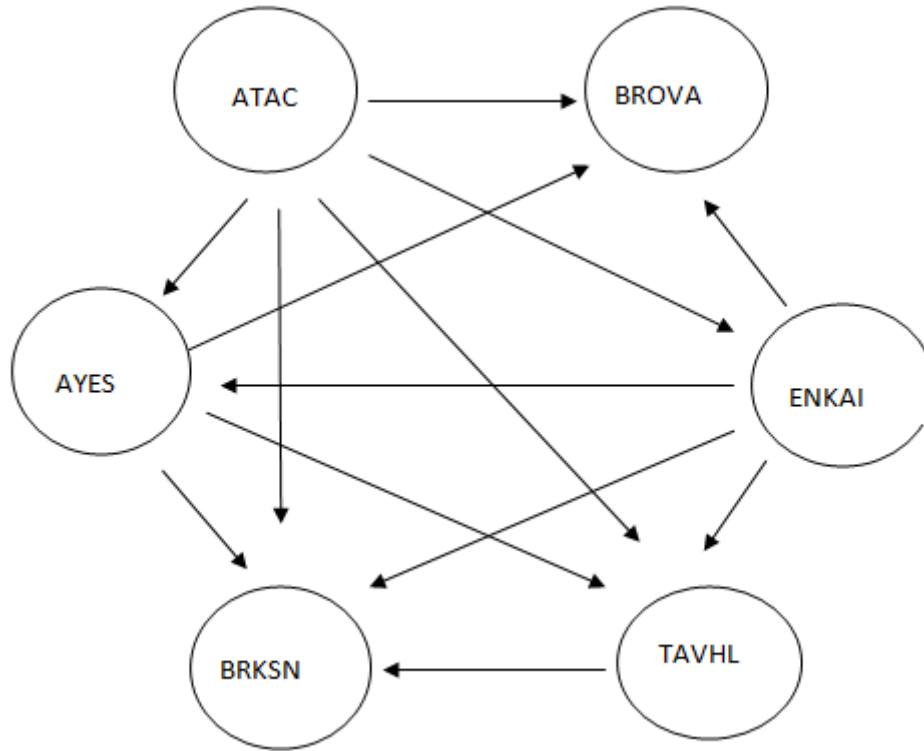


Figure 1: Results of ELECTRE Method

On the created figure, the company that most pointed with arrows show that carried out the worst performance. As seen on the figure, the company that most pointed with arrows is Berkosan Insulation and that company is the last place on the ranking for both methods.

4.3 Calculation of Net Concordance and Discordance Indexes

If the results of ELECTRE method pointed more than one company on the ranking, to achieve clearer ranking, net concordance and discordance indexes must be calculated by the following formula:

$$C_p = \sum_{\substack{k=1 \\ k \neq p}}^m C_{pk} - \sum_{\substack{k=1 \\ k \neq p}}^m C_{kp}$$

$$D_p = \sum_{\substack{k=1 \\ k \neq p}}^m D_{pk} - \sum_{\substack{k=1 \\ k \neq p}}^m D_{kp}$$

Table 7: Net Concordance and Discordance Indexes

Companies	C_{pk}	C_{kp}	$C_{pk} - C_{kp}$	D_{pk}	D_{kp}	$D_{pk} - D_{kp}$	Ranking C	Ranking D
ATAC	3,044	1,956	1,088	1,379	3,796	-2,417	2	1
AYES	2,883	2,117	0,766	1,564	3,404	-1,840	3	2
BRKSN	2,321	2,834	-0,513	3,790	1,209	2,581	-	6
BROVA	1,784	3,332	-1,548	2,968	2,031	0,937	-	4
ENKAI	3,375	1,741	1,634	1,606	3,43	-1,824	1	3
TAVHL	1,864	1,266	0,598	3,834	1,266	2,568	4	5

By using net concordance and discordance indexes in the Table 7, the values of $(C_{pk} - C_{kp})$ are ranked in descending order, the values of $(D_{pk} - D_{kp})$ are ranked in ascending order. If a company has a negative value of $(C_{pk} - C_{kp})$, it does not include to Ranking C (for example BRKSN and BROVA). As can be seen in the Table 7, the company that has the biggest value of $(C_{pk} - C_{kp})$ is ENKA, the company that has the smallest value of $(D_{pk} - D_{kp})$ is ATAC. Furthermore, it can be seen in the column of Ranking C and Ranking D that ATAC has a better score than ENKA in the Table 7.

5. Conclusion

Multi-Objective Decision Methods are allow the comparison of the financial performances of the companies according to specific criteria. For that reason, financial performances of six companies that traded in BIST and operated in construction sector in Turkey are evaluated with TOPSIS and ELECTRE methods using financial statements. On the process of calculation of weights benefited from Analytic Hierarchy Process (AHP).

As result, this study showed that same company carried out the best performance in both methods. Financial performance ranking is resulted as follow ATAC, AYES, ENKAI, BROVA, TAVHL and BRKSN for TOPSIS method, financial performance ranking is resulted as follow ATAC, ENKAI, AYES, TAVHL, BROVA and BRKSN for ELECTRE method.

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